

10699-744(8) Laser spectroscopy (3l, 3p)

2014

Course summary:

Optical spectroscopic diagnostic instrumentation and techniques. Laser spectroscopy techniques for atoms, molecules and plasmas. High-frequency and time-resolved spectroscopy and related diagnostic instrumentation and methods. Attosecond spectroscopy, spectroscopy of organic molecular solids.

Outcomes of course:

To skill students at an advanced level in the concepts, techniques, methods and apparatus needed in laser spectroscopy research.

Lecturer:

Prof. H Schwoerer
Telephone number: (021) 808-3375
E-mail address: heso@sun.ac.za
Office: Room number 1003 in the Merensky Physics Building.

Course content:

RADIATION PARAMETERS:

- a) Einstein A and B transition probabilities,
- b) Relationship with line-strength and oscillator strength,
- c) Intensity, radiance, radiation density.

POPULATION OF ENERGY LEVELS:

- a) Collisional excitation and deactivation,
- b) Radiational excitation and decay,
- c) Dissociation of molecules,
- d) Ionisation.

SPECTRAL LINE PROFILES:

- a) Natural broadening - Lorentz profile,
- b) Thermal motion, Doppler broadening and Gauss profiles,
- c) Convolution of line profiles,
- d) Line broadening mechanisms.

SPECTROSCOPIC INSTRUMENTATION:

- a) Laboratory radiation sources,
- b) Spectrometer configurations,
- c) Radiation detectors and measurement systems.

SPECTROSCOPIC TECHNIQUES:

- a) Atomic emission,
- b) Atomic absorption,
- c) Atomic fluorescence.

LASER SPECTROSCOPY TECHNIQUES:

- a) Laser induced fluorescence
- b) Non-linear laser spectroscopy
- c) Raman and IR spectroscopy
- d) femto- and attosecond spectroscopy
- e) x-ray spectroscopy and Free Electron Laser Physics

Practical (Tutorials):

Not applicable

Study material:

Laser Spectroscopy by W Demtroeder, Third Edition, Springer, "**Molecular physics and elements of quantum chemistry**"
(Springer) Haken and Wolf.

Learning opportunities:

Lectures

Assessment:

Methods of Assessments

Homework problems
Oral presentations

Venue and time of assessment opportunities

As discussed with students.

Availability of marks:

As soon as possible

Calculation of final mark for the module:

50% homeworks + 50% oral presentations